CYMOPHORA (ASTERACEAE: HELIANTHEAE) RETURNED TO *TRIDAX*

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ABSTRACT

Cytological and morphological evidence supports the merger of *Cymophora* B. L. Robinson with *Tridax* L. (Asteraceae: Heliantheae). Chromosome counts of $n = 9$ are reported for *Tridax accedens* Blake and the closely related *T. dubia* Rose. **Tridax hintonii** (Turner & Powell) Keil, Luckow & Pinkava, comb. nov., is proposed, based on *Cymophora hintonii* Turner & Powell.

Our chromosome count of $n = 9$ for *Tridax accedens* Blake (Asteraceae: Heliantheae), the first report for this species, provides key information in an ongoing taxonomic controversy. During the past 20 years several researchers have discussed the status of *Cymophora* and its relationship to *Tridax* (Anderson and Beaman 1968, Turner et al. 1973, Turner and Powell 1977, Canne 1977, 1978, 1983, Robinson et al. 1981, McVaugh 1984). Anderson and Beaman noted numerous morphological similarities between *C. pringlei* B. L. Robins. (at the time the only species of *Cymophora*) and two species of *Tridax* (*T. accedens* and *T. dubia*) and concluded that *Cymophora* could not be maintained separate from *Tridax*. They noted that *C. pringlei* differs mainly from the two *Tridax* species in having smaller, fewer-flowered heads and epappose achenes. It is particularly similar to *T. accedens*. They transferred *C. pringlei* into *Tridax* as *T. oligantha* Anderson & Beaman.

Turner et al. (1973) published a chromosome number of $2n = 16$ (counted by Robert Irving) for *T. oligantha* and questioned the relationship of this species to *Tridax* ($x = 9, 10$). They suggested instead a relationship of *Cymophora* to *Galinsoga* ($x = 8$) and *Sabazia* ($x = 4$). They further suggested that a chromosome count for *T. accedens* would be helpful in evaluating the relationship of *T. oligantha*.

Turner and Powell (1977) reinstated *Cymophora* (as a genus distinct from *Tridax*), transferred *T. accedens* to it and described a third species, *C. hintonii* Turner & Powell. They discounted the purported relationship of *T. accedens* to *T. dubia* (Blake 1943, Powell 1965, Anderson and Beaman 1968), but provided neither a key nor discussed the morphological differences between the two genera.

Canne (1977) noted that *Tridax venezuelensis* Arist. & Cuatr., which bears features of both *Galinsoga* and *Tridax,* is morphologically most similar to species placed by Turner and Powell into *Cymophora,* and transferred this species into *Cymophora.* She further noted that the four species of *Cymophora* fall into two well-defined morphological species groups characterized by differences in leaf shape, petiole length and the number of veins in the phyllaries and pales. *Cymophora hintonii* and *C. venezuelensis* form one group, and *C. accedens* and *C. pringlei* the other. Robinson et al. (1981) again noted the similarity of *T. dubia* to *Cymophora,* but questioned the transfer of *T. venezuelensis* into *Cymophora,* suggesting that it represented a different phyletic line than the remainder of *Cymophora.* They reported an approximate count of $2n$ = ca. 18 for *T. venezuelensis.* Robinson (1981) listed *Cymophora* distinct from *Tridax,* but did not discuss its relationships or composition. Canne (1983) reported $n = 9$ for *C. hintonii* which further weakened the chromosomal basis for distinguishing *Cymophora* from *Tridax.*

Two types of evidence have been used to date in studies of the two genera: morphology and chromosome numbers. Anderson and Beaman (1968) and McVaugh (1984) used morphological evidence to support union of *Cymophora* with *Tridax.* Turner and Powell (1977) and Canne (1977, 1978) used a combination of morphological and cytological data to support their separation of the genera. A review of the conflicting sources of evidence is presented below.

Morphological Evidence

Habit and vegetative morphology cannot be used to separate the two genera. Both genera are composed of opposite leaved herbs. All of the species that have been assigned to *Cymophora* are taprooted annuals. Eleven of the 25 species of *Tridax* (s. str.) are annuals, including *T. dubia,* a species considered to be a link between *Tridax* and *Cymophora* by Anderson and Beaman (1968). Turner and Powell (1977) considered *T. dubia* to be "a true *Tridax*". Canne (1978) listed the following features as distinctive of *Cymophora*: paniculate-cymose capitulescence, zygomorphic outer disc corollas and white corollas. In a tabular comparison of several genera of the Galinsoginae she described the capitulescences of *Tridax* as "heads solitary or in few-headed subcymes" and those of *Cymophora* as "heads in several- to many-headed cymose panicles". Although some *Tridax* species have solitary heads, *T. dubia* and several other species (e.g., *T. platyphylla*) have many-headed cymose panicles. The capitulescences of *T. dubia* and *Cymophora accedens* are similar in appearance and in number and distribution of heads and were used as evidence of the relationship of these taxa and *C. pringlei* by Anderson and Beaman (1968).

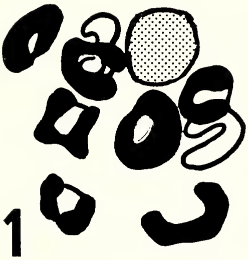
The heads and the included bracts and florets of *Cymophora* species are smaller than those of most *Tridax*. However, *T. dubia* has flowers and bracts similar in size to those of *Cymophora* species. The involucral bracts of *Tridax* are 2–5 seriate and those of *Cymophora* are 1–3 seriate. The species of *Tridax* most similar to *Cymophora* have involucral bracts of similar number and form (Anderson and Beaman 1968). The outer florets of both *Cymophora* and *Tridax* heads tend to be zygomorphic. In most *Tridax* species, these flowers are pistillate and have an evident ligule (anterior lip) and are considered to be rays even though a small posterior lip is present. Rays are absent in several species of *Tridax* and in *T. bilabiata* the disc florets are bilabiate. In three *Cymophora* species, the outer florets are perfect and bilabiate with a short anterior lip and are considered to be bilabiate disc florets (Anderson and Beaman 1968, Turner and Powell 1977, Canne 1978). The fourth species, *C. venezuelensis,* has pistillate, bilabiate outer florets that are treated as rays (Canne, 1977). The remaining disc florets are mostly actinomorphic or nearly so in both genera. Disc corollas in *Tridax* species vary from creamy yellow to bright yellow or yellow-green. Those of *Cymophora* are creamy white.

In *Cymophora,* the achenes may bear short fimbriate or plumose scales or may be epappose. The pappus of most *Tridax* species consists of slender plumose or fimbriate scales or bristles. The pappus of *T. dubia,* however, is similar to that of *Cymophora,* which consists of short, fimbriate-margined scales.

Cytological Evidence

Our count of $n = 9$ for *C. accedens* indicates that two (and possibly three) of the *Cymophora* species share a base of $x = 9$. Both morphological groups recognized by Canne contain species with this base number, as does *Tridax* (including *T. dubia*). In addition, it is possible that the single reported count of $2n = 16$ may be inaccurate. Irving, as listed by Turner et al. (1973), reported a chromosome count of $2n = 16$ from mitotic material. Turner (pers. comm.) notes that a crude penciled camera lucida drawing attached to the voucher specimen (seeds of which served as the source material) does suggest a number of $2n = 16$, but some of the chromosomes may be unresolved and, thus, a count of $2n = 18$ might still hold.

Tridax is dibasic with $x = 9$ and 10. The species of *Tridax* most similar to *Cymophora* have $n = 9$.



FIGS. 1, 2. Camera lucida drawings of chromosomes at diakinesis. 1. *Tridax accedens.* 2. *Tridax dubia.*

CONCLUSIONS

We propose here that continued recognition of *Cymophora* as a genus distinct from *Tridax* is not supported by either morphological or cytological evidence. The closest relatives of *Cymophora* appear to be species of *Tridax* and the morphological characters that separate the genera are weak if they exist at all. Of the characters listed by Canne (1978), only the color of the disc corollas seems to stand up to scrutiny. The cymose paniculate capitulescence of *Cymophora* species is fundamentally similar to the capitulescences of several *Tridax* species. Rayless heads with bilabiate outer disc florets occur in *T. bilabiata* and in *Cymophora* species. We agree with those who consider *T. dubia* and *T. accedens* to be closely related, and, therefore, arrive at the same conclusion as Anderson and Beaman (1968). We suggest that all four species of *Cymophora* be returned to *Tridax.*

McVaugh (1984) arrived at a similar conclusion. Noting the lack of morphological differences between *Cymophora* and *Tridax,* he placed *C. accedens* back into *Tridax.* He did not propose, however, a combination in *Tridax* for *C. hintonii,* but merely listed it (as *Cymophora hintonii*) among the species of *Tridax* in Nueva Galicia. We, therefore, propose the following combination:

Tridax hintonii (Turner & Powell) Keil, Luckow & Pinkava, comb. nov.—*Cymophora hintonii* Turner & Powell, Madroño 24:2. 1977.

We report the following chromosome counts and the voucher specimens that document them:

Tridax accedens S. F. Blake. $2n = 9_{II}$ (Fig. 1). MEXICO: Colima: Hwy. 110, 17 mi ne. of jct. with Hwy. 200, *Keil and Luckow 15139* (OBI).

Tridax dubia Rose. $2n = 9_{II}$ (Fig. 2). MEXICO: Jalisco: 8 mi n. of El Tuito, *Keil and Luckow 15112* (OBI).

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Literature Cited

Anderson, C. E. and J. H. Beaman. 1968. Status of the genus *Cymophora* (Compositae). Rhodora 70:241–246.

Blake, S. F. 1943. Ten new American Asteraceae. J. Washington Acad. Sci. 33: 265–272.

Canne, J. M. 1977. A new combination in *Cymophora* (Compositae: Heliantheae: Galinsoginae). Madroño 24:190–191.

———. 1978. Circumscription and generic relationships of *Galinsoga* (Compositae: Heliantheae). Madroño 25:81–93.

———. 1983. Cytological and morphological observations in *Galinsoga* and related genera (Asteraceae). Rhodora 85:355–366.

McVaugh, R. 1984. Flora Novo-Galiciana. Vol. 12. Compositae. Univ. Michigan Press, Ann Arbor.

Powell, A. M. 1965. Taxonomy of *Tridax* (Compositae). Brittonia 17:47–96.

Robinson, H. 1981. A revision of the tribal and subtribal limits of the Heliantheae (Asteraceae). Smithsonian Contr. Bot. 51:1–102.

———, A. M. Powell, R. M. King, and J. F. Weedin. 1981. Chromosome numbers in Compositae, XII: Heliantheae. Smithsonian Contrib. Bot. 52:1–28.

Turner, B. L. and A. M. Powell. 1977. Taxonomy of the genus *Cymophora* (Asteraceae: Heliantheae). Madroño 24:1–6.

———, ———, and T. J. Watson. 1973. Chromosome numbers in Mexican Asteraceae. Amer. J. Bot. 60:592–596.

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